



## Original communication

Why did the patient die? The relationship between ambulance accidents and death of patients: Forensic medical issues<sup>☆</sup>Gokhan Ersoy MD<sup>a,\*</sup>, Ozlem Ersoy MD<sup>b</sup>, Ozlem Yuksekbas MD<sup>b</sup>, Gulay Kurnaz MD<sup>b</sup>, Elif Ulker Akyildiz MD<sup>c</sup>, Suheyla Ekemen MD<sup>b</sup><sup>a</sup> Istanbul University, Institute of Forensic Medicine, Cerrahpasa kampusu, 34803 Istanbul, Turkey<sup>b</sup> Council of Forensic Medicine, Istanbul, Turkey<sup>c</sup> Uludag University, Medical Faculty, Department of Pathology, Bursa, Turkey

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## ABSTRACT

This article's aim is investigating traumatic consequences of ambulance accident on patients and discussing difficulties to give a decision about the relation between death and accident at these cases. The cases were selected among the forensic medical reports concluded between 1996 and 2005 years. They were documented for age, sex, causes of urgent call, localization and extent of traumatic lesion, properties of events and board decisions. A total of 21 cases were found. 15 cases died on the day of the accident. Skin injuries at head (8 cases) and legs (6 cases) were most common traumatic lesions. Totally 6 deaths were found related with ambulance accident. Death of patient after ambulance accidents may not be associated easily to the accident. Delay due to accident or concomitant contributing medical conditions may also facilitate the death in this type of cases. Reliable medical records were needed for accurate medicolegal evaluation.

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## 1. Introduction

Traffic accidents causing deaths may culminate in lawsuits and compensations and are important parts of forensic medical practice. Ambulances can be involved in traffic accidents due to their high speeds.<sup>1</sup> Unlike vehicles with similar features, ambulances are known to cause higher risk of traffic accidents.<sup>2</sup>

It has been suggested that the risk of traffic accidents caused by ambulances per mile is thirteen times as high as other vehicles.<sup>3</sup> The risk of injuries to occupants of ambulances depends on what time the accidents occur throughout the day and whether the patient has an emergency condition. It has been reported that traffic accidents involving ambulances often occur at traffic lights and crossroads<sup>2</sup> and are more frequent between 12 and 6 p.m. and

that ambulances usually crash into other vehicles and cause higher risk for the occupants in the patient compartments of ambulances.<sup>4</sup> It has been claimed that driving an ambulance with its siren and lights on is more dangerous.<sup>5</sup>

In accidents involving ambulances, ambulance staff, patients transported in ambulances and passengers accompanying patients may be injured or even die. It has been reported from the USA that death rates are more than two times higher in emergency medical staff than in other medical staff and that most of these deaths are due to traffic accidents, which are mostly caused by ambulances.<sup>6</sup> In a study using a questionnaire on emergency staff in Kansas City, about half of the participants reported to have at least one ambulance accident during their lifetime.<sup>7</sup>

It has been noted in the literature that people traveling in the patient compartment of ambulances are more frequently injured and more frequently died. The literature concerning ambulance staff reveals that the staff sitting in front more frequently died in traffic accidents than the staff traveling at the back.<sup>4,8</sup> However, to our knowledge, there have not been any studies on traumatic effects of ambulance accidents on patients transported in ambulances and resultant forensic medical problems. In fact, unlike occupants in the patient compartments of ambulances, the patients transported in ambulances are likely to be affected by ambulance accidents. This threatens patients' health and is important in terms of

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forensic medical ethics as in other injuries due to other accidents. There may be difficulties in determining causes of death of patients with serious diseases after ambulance accidents. For example, to what extent ambulance accidents affect survival of patients transported in ambulances and what exactly causes the death of patients after these accidents may be difficult to detect.

This study included patients dying in ambulances after ambulance accidents. The starting points of the study were as follows: 1) Unlike occupants of other vehicles, patients in ambulances are usually in a different position (in the supine position and their heads lean forward). Therefore, it is important to record lesions. 2) If ambulances are requested to transport patients having another accident, it can be difficult to evaluate the lesions caused by the second accident and to differentiate them from those caused by the first accident. The aim of this study was to evaluate lesions caused by ambulance accidents in patients during their transport by ambulances and more importantly to reveal difficulties in forensic medical evaluation of these lesions.

## 2. Materials and methods

Data were collected from the reports issued by the First Board of Council of Forensic Medicine (CFM). The Scientific Board of Council of Forensic Medicine was reviewed and approved this study.

The First Board of Council consists of specialists of the field of internal medicine, surgery, neurosurgery, gynecology and obstetrics, anesthesiology, pathology and forensic medicine and deals with forensic cases with lethal outcomes. Boards of CFM offer expert opinions. They only evaluate cases referred by all courts and they are requested expert opinion. Members of the boards examine medical and forensic documents sent by the courts and record all findings and their decision in their reports of the cases.

We retrospectively examined 25553 cases evaluated by the First Board of CFM between 1996 and 2005. The reports about 21 patients having an accident during their transport by an ambulance and dying after that accident were included into the study. The courts requested the board to determine whether deaths of the patients were due to ambulance accidents.

Data about age, gender, traumatic lesions recorded before and after ambulance accidents, causes of deaths, survival after ambulance accidents, autopsy, relation between deaths and ambulance accidents, types of ambulance accidents, place of accidents (city or highways) and departures and destinations of ambulances (from a place where the ambulance was called to health institutions/from one health institution to another health institution) were collected from the reports.

Traumatic lesions documented after accidents were compared with medical conditions prior to accidents. Obtained data were used to reveal the lesions created during ambulance accidents and relationship between accidents and deaths and forensic medical difficulties in determining this relationship.

## 3. Results

There were 21 deaths found to be associated with ambulance accidents between 1996 and 2005. The parameters investigated in all cases are shown in Table 1.

The cases were aged 0–92 years with a mean of  $47 \pm 27$  and median of 52 years. Survival after the accidents ranged from 0 to 50 days (Median: 0 day). Fifteen deaths occurred on the day when the accidents happened.

Ambulances were called due to a disease already present in eleven deaths (*Pathologic Group*) and due to a trauma caused by accidents in the rest ten deaths (*Traumatic Group*). The patients in Pathologic Group usually had chronic diseases. They were taken to

ambulances mostly due to dyspnea. One patient was a newborn baby. Another patient was pregnant when she had an ambulance accident and the baby was delivered four days after the ambulance accident and died 11 days later. All but one patient in Traumatic Group (Case 20) had traffic accidents or was run over by a tractor. Details about causes of ambulance transportation are shown in Table 1.

Of all ambulance accidents, 12 were crashes of two vehicles, 4 were rollovers and 1 was run-off-road collision. There was no recorded information about the type of collision in four cases.

There was not any recorded information about in what position the patients were taken to ambulances, whether stretchers were secured to the ambulance and whether the patients were secured to the stretchers in the reports. In the reports, the relatives of only three patients noted that the patients and the stretchers were rolled in the ambulance.

Fourteen ambulance accidents (70%) occurred on highways and 6 on roads in cities, but the accident scene was unknown in one case. Six patients were being transported from the place where it was called to the health center in the city (Cases 1–4, 11, 17) and 15 patients (71%) were being transported from one health center to another when ambulance accidents occurred. Nine patients in Traumatic Group (90%) had ambulance accidents while they were being transported from health center to another. Ambulance accidents mainly occurred on highways while the patients were being transported from one health center to another after traffic accidents.

Medical documents about health status of all the patients after ambulance accidents were available and 12 patients (57%) had autopsy.

Medical documents about health status of 15 patients before ambulance accidents, who had accidents while being transported from one health center to another, were available. Examinations of these documents showed that none of the patients in Pathologic Group had traumatic lesions before the accidents as expected. However, all patients in Traumatic Group had poor vital signs, life threatening lesions and fractures located on different parts of the body, mainly on the skull (Table 1). Only five patients had external skin and soft tissue lesions. The remaining five patients (cases 14, 15, 16, 19 and 20) did not have these signs or the following explanations were found in the reports: "...had multiple traumas due to traffic accidents (Case 14)...had grazes on various parts of the body (Case 16).

Medical documents about health status before the accidents were not available for any of six patients having ambulance accidents while being transported from the scene to a health center. The board made use of testimonies of ambulance staff and relatives of these patients to evaluate their pre-accident health status.

### • Traumatic consequences of ambulance accidents

Comparison of pre- and post-accident health status of the patients in Traumatic Group made to determine traumatic outcomes of ambulance accidents showed that the accidents caused fractures in the skull in Case 19, in the clavicle in Case 20 and in the humerus and vertebrae in Case 21. In the remaining seven patients of Traumatic Group, the lesions caused by the first trauma could not be differentiated from those caused by ambulance accidents (Table 1).

Data about ambulance accidents related injuries from Pathologic Group, who did not have any traumatic lesions before ambulance accidents, were more reliable. The accidents caused multiple fractures and subdural hematoma in one case, fractures of the extremities in two cases. Out of 11 cases, 10 had lesions due to blunt traumas such as ecchymosis, abrasion and laceration. These soft tissue/skin lesions were located in the head in 8 cases, the lower extremities in 6 cases and both the head and the lower

**Table 1**  
 Characteristics of patients dying after ambulance accidents. It is worth to point out traumatic lesions due to ambulance accidents could not be usually differentiated from those due to prior accidents in the last 10 patients who were taken to ambulances due to traumas. AA: ambulance accident, AAP: acute abdominal pain, CHF: chronic heart failure, COPD: chronic obstructive pulmonary disease, CP: cor pulmonale, DCM: dilate cardiomyopathy, DM: diabetes mellitus, HUS: hemolytic uremic syndrome, HT: hypertension, LC: lung carcinoma, MC: metastatic carcinoma, RDS: respiratory distress syndrome. RF: renal failure, RoD: rotator disease, Tbc: tuberculosis.

Case no	Age	Why ambulances were called	Where ambulances set out	Where AAs occurred	Medical conditions before AAs	Medical conditions after AAs	Survey after AAs (day)	Autopsy	Pathologies due to AAs	Causes of deaths	Relation between death and AAs (board decision)
1	63	Dispnea	Home	Urban	COPD + DM + Paraplegia	Tibial fracture	0	+	Tibial fracture	Natural death	No
2	80	Dispnea	Home	Urban	COPD + CHF + CP	Fractures of the vertebra, scapula, and costa; quadri paresis, subdural hematoma, spinal contusion	50	+	Fractures of the vertebra, scapula and costa; quadri paresis, subdural hematoma, spinal contusion	Complications due to brain and organ injury	Direct traumatic effect of AAs; chronic diseases contributed to death
3	58	Dispnea	Home	Urban	LC + DM + HT	External lesions on the lower extremities	0	+	External lesions on the lower extremity	Natural death	No
4	92	Vomiting	A rest home	Urban	CHF + RoD	External lesions on the extremities and head	10	–	External lesions on the extremities and head	Natural death	No
5	69	Dispnea AAP	Hospital	Urban	CHF + RF	External lesions on the extremities and head	0	+	External lesions on the extremities and head	Cardiac disease activated by stress of trauma	Yes
6	52	Syncope	Hospital	Urban	COPD + HT + Hemiplegia	External lesions on the head; acute myocardial infarct at autopsy	0	+	External lesions on the head	Ischemic heart disease	No
7	64	Dispnea	Hospital	Urban	Tbc + MC at liver	External lesions on the upper the extremity, trunk and head; Fracture of the humerus	0	+	External lesions on the upper extremity, trunk and head; humerus fracture	Acute respiratory and cardiac arrest due to trauma complicated by chronic disease at the base.	Both trauma and chronic diseases contributed to death
8	60		Hospital	Rural (2 separate AAs)	DCM + RF + uremic acidosis	External lesions on the extremities and head	0	–	External lesions on the extremities and head	Unknown	Unknown
9	0	Dispnea	Hospital	Urban	Newborn (RDS)	External lesions on the trunk and head	1	+	External lesions on the trunk and head	Hyaline membrane disease	No
10	0	A pregnant women having traffic accident	Hospital	Rural	In utero fetus whose mother had RF and HUS	Pregnant woman had vertebral fracture but good health status and gave birth to her 28-week and 730gr.-baby 4 days after AA; the baby died 11 days later.	15	–	Compression fracture of the second thoracal vertebra in the mother, but no traumatic pathology in the fetus	Complications due to prematurity	No
11	40	Dispnea	Holiday resort	Rural	Unknown	External lesions on the lower extremity and head	0	–	External lesions on the lower extremity and head	Unknown	Unknown
12	36	Traffic accident	Hospital		External lesions on the head; cranial fracture	External lesions on the extremities, trunk and head; Cranial fracture Brain damage and liver laceration at autopsy	0	+	External lesions on the extremities and trunk	Death due to head trauma	No
13	5	Struck by a truck	Primary health care center	Rural	External Lesions; cranial fracture	External Lesions, Cranial fracture, Brain damage at autopsy	0	+		Death due to head trauma	No

Table 1 (continued)

Case no	Age	Why ambulances were called	Where ambulances set out	Where AAs occurred	Medical conditions before AAs	Medical conditions after AAs	Survey after AAs (day)	Autopsy	Pathologies due to AAs	Causes of deaths	Relation between death and AAs (board decision)
14	80	Traffic accident	Hospital	Şehir dışı	Multiple lesions; rib fracture	Widespread external lesions Tibia, fibula, rib fractures, Liver laceration at autopsy	0	+	Lesions due to two accidents could not be differentiated	Death due to internal bleeding	No
15	27	Traffic accident	Hospital	Rural	External lesion? cranial fracture	External lesions on the extremities, trunk and head; Cranial fracture	0	–		Death due to head trauma	No
16	74	Struck by a truck	Primary health care center	Rural	Miscellaneous grazes; fractures of the rib and tibia; otorrhagie	External lesions, Fractures of the rib and tibia, Cranial fracture	0	–		Death due to head trauma	No
17	21	Traffic accident	Accident scene	Rural	External lesions on the lower extremities and head (limited information); tibia fracture	widespread external lesions, fractures of the tibia and pelvis, laceration of the lungs and iliac artery at autopsy	0	+	No lesions due to AA	Death due to internal bleeding	Yes (AA caused a six-hour-delay in treatment)
18	34	Traffic accident	Hospital	Rural	Widespread external lesions; fractures cranial fractures?	widespread external lesions, Fractures of the lower extremities, Cranial fractures, Intracranial hematoma at autopsy	0	+		Death due to head trauma	No
19	59	Traffic accident	Hospital	Rural	External lesion? Fractures of the upper extremities?	External lesions on the head, Fracture of the upper extremities, Scalp laceration and possible cranial fracture	0	–	Laceration of the scalp and possible fracture were attributed to AA	Traumatic death	Yes (both accidents were associated with death)
20	37	Fall off a tree	Hospital	Rural	External lesion? Vertebral fracture, spinal damage, paraplegia	External lesions on the lower extremities and fractures of the trunk, vertebra and clavicle	6	–	Clavicle fracture was attributed to AA.	Traumatic death	No
21	30	Traffic accident	Hospital	Rural	External lesions on the head	External lesions on the head, Fractures of the humerus and vertebra	6	–	Fractures of the humerus and vertebra were attributed to AA.	Traumatic death	Yes (direct effect of AA)

extremities in 5 cases. In addition, the lesions were located in the arms of 2 cases and in the trunk of 3 cases. Evaluations of effects of ambulance accidents made by the board are presented in Table 1.

#### • Whether ambulance accidents caused death or not

Examination of the board reports about the relation between ambulance accidents and death of patients showed that the board did not make any comments about this relation in Cases 8 and 11 (Table 1); Case 8 had two consecutive ambulance accidents. Although these two cases were taken to ambulances from a hospital, there was not detailed medical information about the type of traumas. Although the patients were reported to have poor health status, there was not enough evidence to attribute it to traumas or diseases already present and the patients did not undergo autopsy. Case 11 did not have autopsy and there was not a medical document or information about pre-accident medical conditions. Therefore, the board could not make any comments about the relation between death and the ambulance accident.

Ambulance accidents were found to play a role in death of 6 patients (Table 1; Cases 2, 5, 7, 17, 19 and 21): Case 2 lived for 50 days in hospital despite severe traumatic changes. Although death was attributed to the ambulance accident, chronic diseases were reported to predispose to death of this patient.

Case 5 had amyloid deposits and hypertrophy of the heart and obstruction of the coronary arteries. Death was attributed to the patient's cardiovascular disease activated by trauma to the body.

Similarly, Case 7 had dispnea before the accident and worse general health status after the accident. Autopsy showed traumatic lesions in addition to purulent pneumonia and metastatic carcinoma in the liver. Traumatic lesions superimposed on the chronic diseases were reported to cause death.

Case 17 had open fractures and bleeding in the leg following a traffic accident. Although the subsequent ambulance accident was not serious and the ambulance staff did not get injured and death was attributed to trauma due to the prior traffic accident, a 6-h-delay in taking the patient to hospital due to the ambulance accident was considered as an important factor in death.

Case 19 had poor health status and was unconscious, but did not have a head trauma after an accident. Although autopsy was not performed after the ambulance accident, coronary examination revealed frontal fracture. The board determined that both accidents might have caused death of the patient.

Case 21 had good health status and did not have a life-threatening condition after an accident, but died after the ambulance accident. The patient did not undergo autopsy, but X-ray of the humerus and vertebrae showed fractures and death was attributed to the ambulance accident.

Death was not associated with ambulance accidents in the remaining patients. They had already poor health status and ambulance accidents were not found to cause additional lethal traumas.

- Other supporting evidence

Another evidence for the severity of accidents is medical information about other occupants of ambulances, which could be obtained from testimonies of witnesses for 14 patients. Concerning 10 patients, the occupants of the ambulances did not have injuries, but only trivial, superficial lesions. An ambulance driver died in an ambulance accident and another ambulance driver was injured in another ambulance accident. One patient's relative died in an ambulance accident and one patient's relative was injured in another ambulance accident. In the latter three cases, death was attributed to ambulance accidents in the reports.

#### 4. Discussion

It should be kept in mind that the cases included in this study do not represent all deaths from ambulance accidents during a period of time. In practice, most of the forensic medical cases are solved on the spot and CFM is not requested to solve the cases. Therefore, the results of this study cannot reveal factors increasing the risk of death after ambulance accidents, features of these accidents and the most frequent type of ambulance accidents causing death. The cases included in this study were the cases difficult to solve in the courts and referred to CFM from many parts of Turkey in ten years. The most frequent manner of accidents was that patients with prior widespread trauma had accidents on highways while they were transported from one health center to another. This type of accidents can also be considered as the one which was the most difficult solve.

At first sight, it seems difficult to determine whether deaths occurring after ambulance accidents are due to ambulance accidents. Death of patients after ambulance accidents poses the question whether these patients have died from these accidents or medical conditions which cause these patients to be transported in ambulances. In fact, out of 21 deaths referred by the courts to the First Board of Council of Forensic Medicine, only six (28.5%) were associated with ambulance accidents. This is not surprising in that most of the patients had a life-threatening condition, severe trauma or chronic disease at the terminal stage. Even if they had not had ambulance accidents, they had had a high risk of mortality. Only Case 21 had a good health status before the ambulance accident and death of this patient was associated with the accident. It is clear that effects of ambulance accidents can easily be determined by local authorities without referring them to CFM in deaths of patients with mild medical conditions before. Pathologies and traumas before ambulance accidents were so severe that they were reported to be contributing factors in death of 5 out of 6 patients dying after ambulance accidents (except for Case 21). In other words, their effects could not be excluded. Only Case 21 turned out to die due to the ambulance accident only, without contribution of another factor. In view of the findings above, it should be kept in mind that *dying after an ambulance accident does not mean dying due to the ambulance accident*. It is quite likely that pathologies and traumas requiring transportation of the patients in ambulances caused death of the patients and that ambulance accidents were just incidental and had minor effects on death of the patients.

Another question likely to emerge is whether the delay in transport of patients to hospital due to ambulance accidents is associated with death of patients. In fact, ambulance accidents may not directly cause deaths, but the resultant delay may be indirectly

responsible. This delay is especially important for the patients requiring surgical treatment. Case 17 was found to receive delayed treatment and die from iliac artery bleeding due to pelvic fracture. Therefore, time elapsing from putting a patient in an ambulance and taking him to hospital together with pre-accident health status of patients should be taken into account. It is clear that a delay longer than acceptable limits may lead to death of a patient likely to recover otherwise.

Determination of the role of ambulance accidents in deaths of patients can be quite difficult and the most important evidence is medical records kept before and after ambulance accidents. However, ambulance staff may not have time to keep these records when they perform interventions on patients with life-threatening conditions. Missing information in these documents is obtained from testimonies of health staff, patients' relatives and other people. This situation is true for five deaths in Pathological Group in the present study. These five patients were taken to ambulances from their homes and the ambulances caused accidents on the way to hospital. Information about patients' health status before the accidents was obtained from testimonies of health staff and patients' relatives. It is clear that ambulance staff should be interrogated about medical parameters of the patients and that obtained information should be recorded *as soon as possible* to obtain reliable data. Even though testimonies of patient relatives have secondary importance, they may be required in some cases. In this study, two patients' relatives reported that the patients died long before the ambulance accidents (Cases 1 and 14).

In Traumatic Group, the patients had an ambulance accident during their second transfer to another hospital. Medical reports about these patients included more details compared to those about Pathological Group. Vital functions and traumatic signs were recorded relatively carefully. However, external lesions were usually overlooked. These lesions should have been more carefully recorded especially in cases of traumas before they were taken to the ambulance since the patients had many traumas. One favorable finding of this study was that vital functions and fractures were ideally recorded in medical and court documents. However, it should be remembered that external lesions were neglected.

When patients die after an ambulance accident, latest medical and autopsy findings are compared with findings obtained at the beginning. In the present study, nine patients did not undergo autopsy and death was determined based on physical examination only. This might have caused difficulties for the board. Findings from physical examination and medical records made after ambulance accidents may provide important information about deaths after ambulance accidents if autopsy has not been performed. In fact, even they were missing in two cases in the present study. Therefore, the board failed to determine whether there was a relation between deaths and ambulance accidents.

The distribution of traumatic lesions caused by ambulance accidents showed that they were mostly located in the head and legs. The head and the legs were vulnerable to traumas since they can move freely. In addition, patients are positioned in ambulances in a way that their heads are in the front and their legs are at the back of ambulances. Unless patients are secured safely, they become vulnerable to traumas. Since the position of patients in ambulances and whether the patients were fixed to the stretcher and whether the stretchers were fixed to the ambulance were not recorded, the data available were insufficient to comment on the distribution of the lesions in this study.

Another striking finding was that all but one case of multiple fractures (in the vertebrae, scapula and costas) did not have lethal traumas. This patient with lethal trauma was 80 years old and this might have contributed to subdural hematoma and numerous bone fractures. Lack of lethal traumas in most of the cases suggests that

ambulance accidents did not have severe effects, which is supported by the finding that 10 out of 14 patients and other occupants of the ambulances did not have serious injuries. It has been reported that ambulance accidents which occurred in urban areas had less serious effects than those in rural areas.<sup>9</sup> In view of the fact that all occupants of ambulances, especially those in the back compartment were under risk of injuries and deaths, one can say that the ambulance accidents did not have a serious impact on 10 cases in the present study.<sup>10</sup>

Lack of serious injuries can be explained by other factors. The patients might have been fixed to the stretcher, which have decreased the severity of the accidents. In addition, since the patients were lying during the accidents, resistance to friction might have prevented the patients from moving freely, which might have decreased the severity of traumas. Unfortunately, we cannot comment on this issue since we do not have relevant data.

To conclude, patients transported in ambulances like other occupants of ambulances are at high risk of injuries. Medical records made carefully, testimonies recorded in time and physical reconstruction accidents can help forensic pathologists to determine the relation between deaths of patients after ambulance accidents and the accidents themselves. The documents which can be utilized in such cases can be listed as in the following in the order of importance:

1. autopsy reports and reports of physical examination of deaths
2. all medical documents recorded before and after ambulance accidents
3. court testimonies of all medical and ambulance
4. forensic documents about how ambulance accidents have occurred
5. testimonies of deaths' relatives and witnesses

The first step in evaluation is to reveal differences in medical problems before and after the accidents. It is clear that the role of pathologies and traumas before the accidents in deaths of patients

with poor status and vital functions can never be disregarded. Furthermore, effects of delayed intervention as well as traumatic effects of ambulance accidents should be taken into account when deaths following ambulance accidents are evaluated.

#### Conflict of interest

None declared.

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None.

#### Ethical approval

These study was approved by Scientific Committee of Council of Forensic Medicine.

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